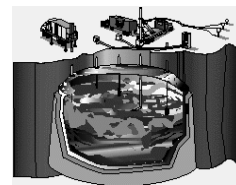




## Automated Monitoring System for Fluid Level and Density in High-Level Waste Tanks



**Developer:** Science & Engineering Associates, Inc.  
**Contract Number:** DE-AC21-96MC33126  
**Crosscutting Area:** CMST

**Tanks**  
**FOCUS AREA**

### Problem:

During 50 years of nuclear weapons development, DOE has produced millions of gallons of high-level radioactive and mixed waste. This waste is primarily stored in underground tanks at DOE sites across the country. Many of these tanks are of single wall construction. Finding ways to determine the fluid level and density inside, has always been of great concern. Tapping on the side of tank and then listening to the response at different levels is a simple yet standard method for locating fluid levels in tanks. This method, however is not always accurate when applied to high-level waste tanks.

### Solution:

A real-time continuous monitoring system of waste fluid levels and fluid densities in DOE waste tanks. The system will consist of a string of small piezoelectric elements placed inside of an existing liquid observation well. A small force will be exerted on the tank wall producing sound waves. These sound waves will be detected by the

piezoelectric elements and multiplexed to provide real time information on the tank waste fluid level and fluid density.

### Benefits:

- ▶ Monitor fluid levels on a real-time basis with a spatial resolution of 1 cm
- ▶ Promptly alert site personnel to changes in fluid levels and densities
- ▶ Implementation of the system through existing liquid observation wells (LOWs) in tanks at Hanford
- ▶ Ability to monitor fluid densities on a real-time basis in order to determine stratification of waste contents

- ▶ Able to monitor the bottom of the LOW

### Technology:

This technology is to measure liquid densities through acoustic techniques. This will allow determination of liquid/air boundaries and the makeup of interstitial layers. One of the

simplest ways to determine the density of a material on the opposite side of a barrier is to tap on the barrier and listen to the response. This is the method used to find studs behind dry-wall and is also used to determine liquid levels in tanks. In essence this is analogous to this technology. However, one cannot simply walk up to the side of a million gallon underground storage tank and tap on it. The challenge lies in applying this simple technique to the complicated situation of determining the liquid levels and densities of DOE high-level waste tanks. The solution must quantitatively determine liquid densities and assess liquid levels with relatively high resolution.

The basis of this technology is to place a large number of small "tapping" and "listening" devices into a LOW running through the tank waste. This can be done through the use of ceramic piezoelectric transducers. These devices can be custom shaped and made in very small geometrics. Therefore, a large number of them can be placed in a very compact arrangement.



A string of piezoelectric transducers will be lowered into an existing LOW pipe and bound to the interior wall. A pulse generator located at the surface above the tank induces a very short duration voltage pulse. This causes the piezoelectric ceramic to mechanically displace and effectively "tap" the pipe wall. The same element or an identical one is used to measure the response of the "tap" on the pipe wall. The response data is recorded by an instrument such as a spectrum analyzer or digital oscilloscope. The recording instrument is connected to an RF modem, which transfers data to a central computer for data analysis and recording. Alarm functions are built into data analysis routines to alert site personnel to any notable changes in the tank contents.

#### Contacts:

Science and Engineering Associates, Inc. (SEA), is a high technology contract R&D organization providing services to the national needs. The Environmental Technologies Division of SEA develops, demonstrates, and provides field services in the areas of environmental characterization, monitoring, and remediation. For

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